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Inventors	:	Yuichiro Iguchi Masahiro Matsumoto Yuko Mikami Takaki Masaki Takao Sano Yoshiyuki Kitamura Yoshinori Tani Hideki Ikeuchi	Docket No.: 1084-98 Confirmation No.: 7453
Title	:	A METHOD AND APPATATUS FOR PRODUCING A PLASMA DISPLAY	

Declaration of Mr. Yuichiro Iguchi

Mail Stop Amendment
Commissioner for Patents
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Sir:

1. I, Yuichiro Iguchi, declare that I reside at Otsu-shi, Shiga, Japan, that I am one of the inventors named in the above-identified U.S. Patent Application. I am, and have for many years been, an employee of Toray Industries, Inc. of Tokyo, Japan. I am thoroughly familiar with the technology relating to methods and apparatus for producing plasma displays since June, 1995.

2. I am familiar with Nanto et al. (U.S. Patent 5,921,836), one of the cited references in the outstanding Official Action, which describes an apparatus for forming fluorescent layers in a plasma display panel by applying a fluorescent paste into grooves formed between a plurality of parallel ribs disposed on a surface of a substrate.

3. I, together with the co-inventors, discovered that, when the number of needle-type nozzles contained in a phosphor paste dispenser exceeded 30, it becomes difficult to produce a substrate for a plasma display having precise coatings between the barrier ribs.

Specifically, irregularities occurred in the coatings between the barrier ribs. In addition, coatings of phosphor paste were sometimes found on the top surfaces of the barrier ribs. After that, I, together with the co-inventors, experimented by replacing the dispenser having the needle-type nozzles with a dispenser having outlet holes provided in a flat plate. Unexpectedly, we discovered that, when the number of the outlet holes was from 150 to 2000, we could easily produce a substrate for a plasma display having precise coatings between the barrier ribs.

4. It is possible to produce a plasma display having precise coatings between the barrier ribs using a dispenser having 5 - 30 needle type nozzle as disclosed in Nanto et al. However, in Nanto there are no teachings or suggestions that, when the number of needle-type nozzles exceed 30, it becomes difficult to produce a substrate for a plasma display having precise coatings between the barrier ribs. There are no teachings or suggestions in Nanto et al. that the problem of the needle-type nozzle would be solved by using a dispenser having outlet holes provided in a flat plate. In other words, one skilled in the art, after reading Nanto et al., would fail to appreciate that the problem found with more than 30 needle-type nozzles would not be repeated when using many holes in a flat plate. I believe that our important discovery is not taught or suggested by Nanto et al.

5. I have conducted the following experiments to demonstrate the difference in effect between a paste applicator having 64 outlet holes provided in a flat plate of the bottom surface of the applicator (the same one used in Example 1 of the present Specification) and a paste applicator having 32 needles protruded from the bottom surface of the applicator.

6. I have also conducted the following experiments to show the difference in effect between a paste applicator having 64 outlet holes provided in a flat plate of the bottom surface of the applicator (again, the same one used in Example 1 of the present Specification) and a past applicator having 640 outlet holes provided in a flat plate of the bottom surface of the applicator (the same one used in Example 4 of the present

Specification). The experiments and the results are described in the following paragraphs.

Experiment 1

7. A glass substrate that is the same as the glass substrate disclosed in Example 1 of the present Specification was used in the experiment. As phosphor pastes for red, green and blue, the same phosphor pastes for red, green and blue disclosed in Example 1 were used respectively. As a paste applicator for applying each of the phosphor pastes, the paste applicator disclosed in Example 1 was used. That is, a paste applicator having 64 outlet holes with a diameter of 150($\pm$1) μm and a length L (see Fig. 2) of 2($\pm$0.05) mm and formed at a pitch of 660 μm in a flat plate was used. Herein, the paste applicator is referred to as "a hole-type paste applicator."

8. The glass substrate having the barrier ribs was coated with the phosphor pastes by using an apparatus shown in Fig. 3 of the Application.

9. The distance between the top ends of the barrier ribs formed on the glass substrate and the tips of the outlet holes of the paste applicator was kept at 0.1 mm while the red phosphor paste was coated onto the substrate using the paste applicator. During the coating, the paste applicator filled with the phosphor paste was pressurized for continuous application, and moved at a speed of 50 mm/sec in a direction parallel to the barrier ribs.

10. During the coating process, a pressure of 385 Mpas was applied in case of red, 370 Mpas was applied in case of green and 280 Mpas was applied in case of blue. Coating was terminated when the paste applicator progressed to the end of the substrate. A negative pressure was applied to reduce the pressure in the past applicator 0.1 second before the paste applicator reached the ends of barrier ribs. Then, the paste applicator was moved by 42.24 mm in the direction perpendicular to the ribs, and the phosphor paste was applied to the next 64 barrier ribs. After repeating 10 consecutive coatings in this way, 640 lines were formed in every three spaces between the respectively adjacent barrier

ribs. Then, the coating was dried at 80℃ for 15 minutes. Similarly, the spaces between the barrier ribs on the immediate right of each space coated with the red phosphor paste were coated with the green phosphor paste. Then, the spaces between the barrier ribs on the immediate left of each space coated with the red phosphor paste were coated with the blue phosphor paste.

11. The substrate coated with the red, green and blue phosphor pastes was burned at 460℃ for 15 minutes, and evaluated. The evaluation results are shown in Table Exp-1 attached hereto.

Experiment 2

12. A paste applicator having 32 needle-type nozzles similar to those shown as nozzles 56a in Figs. 15 and 16 of Nanto et al., having a diameter of 150(±20) μm and a length of 5(±0.2) mm and formed at a pitch of 660 μm was prepared. This paste applicator is referred to as "a needle-type paste applicator."

13. A phosphor layer was formed as described in Experiment 1, except that the needle-type paste applicator was used instead of the hole-type paste applicator used in Experiment 1 and, during the coating process, a pressure of 950 Mpas was applied in case of red, 850 Mpas was applied in case of green and 700 Mpas was applied in case of blue. The evaluation results are shown in Table Exp-2 attached hereto.

Experiment 3

14. A partial picture of the surface of the substrate finally obtained in Experiment 1, which was produced by 10 consecutive coating passes ("a sectional coating") was taken by a line-camera for inspection of the condition of the surface. The picture obtained is shown in Photo Exp-3 attached hereto.

Experiment 4

15. A partial picture of the surface of the substrate finally obtained in Example 4 of the present Specification, which was produced in a single pass ("a single pass coating"),

was taken by a line-camera for inspection of the condition of the surface. The picture obtained is shown in Photo Exp-4 attached hereto.

Experimental Results and Conclusions

16. It is recognized from Table Exp-1 that the distribution of the thickness of the phosphor paste on the bottom wall in the barrier rib for the red phosphor paste is 2 μ m, for the green phosphor paste is 3 μ m, and for the blue phosphor paste is 3 μ m.

17. In contrast, it is recognized from Table Exp-2 that the distribution of the thickness of the phosphor paste on the bottom wall in the barrier rib for the red phosphor paste is 7 μ m, for the green phosphor paste is 5 μ m, and for the blue phosphor paste is 6 μ m.

18. It is understood from Tables Exp-1 and Exp-2 that the thickness distribution difference between the substrate formed by the hole-type paste applicator and the substrate formed by the needle-type paste applicator is quite dramatic. It is difficult to use the substrate formed by the needle-type paste applicator for a plasma display to be marketed commercially. In contrast, the substrate formed by the hole-type paste applicator is highly acceptable for use in a plasma display to be put on the market.

19. It is recognized from Photo Exp-3 that the surface of the substrate produced by the sectional coating differs in appearance among the consecutively coated surface areas.

20. It is recognized from Photo Exp-4 that the surface of the substrate produced by the single pass coating has an even appearance throughout the surface.

21. It is understood that the substrate produced by sectional coating having the non-uniform appearance cannot be used for assembling a high quality plasma display to be marketed commercially. In contrast, the substrate produced by the one pass coating having a uniform appearance is highly acceptable for use in assembling a high quality plasma display to be put on the market.

The undersigned declares that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and,

further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and thus such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: October 24, 2005

Yuichiro Iguchi

Yuichiro Iguchi, Co-inventor

Table Exp-1

Color	Thickness of side wall (μ m)	Thickness of bottom wall (μ m)	Thickness distribution of the thickness bottom wall (μ m)	Deposition on top ends of barrier ribs	Mixing of colors
Red	18.7	18.7	2	Did not occur	Did not occur
Green	20.7	21.9	3	Did not occur	Did not occur
Blue	21.5	21.3	3	Did not occur	Did not occur

Table Exp-2

Color	Thickness of side wall (μ m)	Thickness of bottom wall (μ m)	Thickness distribution of the thickness bottom wall (μ m)	Deposition on top ends of barrier ribs	Mixing of colors
Red	19.2	19.0	7	Did not occur	Did not occur
Green	22.4	20.4	5	Did not occur	Did not occur
Blue	20.2	20.5	6	Did not occur	Did not occur

Photo Exp-3

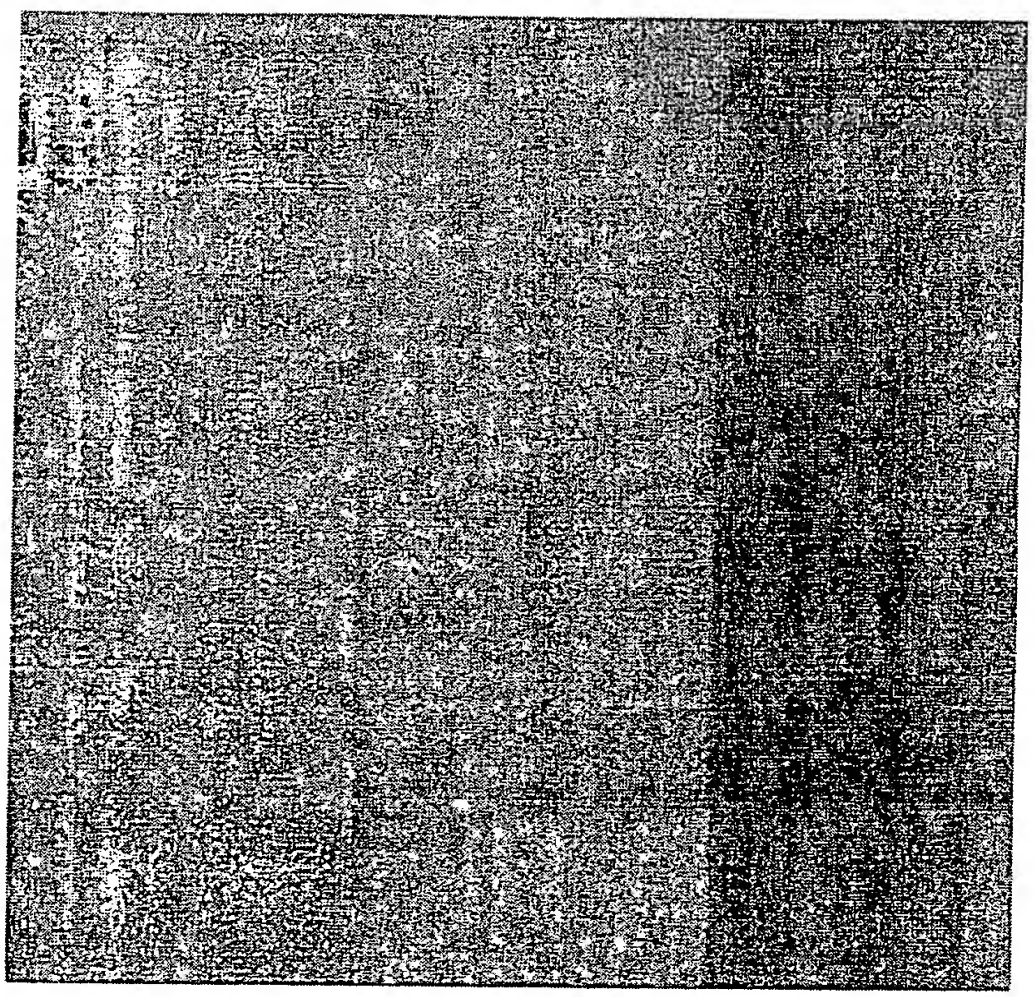

Photo Exp-4